We assess evidence relevant to Earth’s equilibrium climate sensitivity per doubling of atmospheric CO2, characterized by an effective sensitivity $S$. This evidence includes feedback process understanding, the historical climate record, and the paleoclimate record. An $S$ value lower than 2 K is difficult to reconcile with any of the three lines of evidence. The amount of cooling during the Last Glacial Maximum provides strong evidence against values of $S$ greater than 4.5 K. Other lines of evidence in combination also show that this is relatively unlikely.

In this report we thoroughly assess all lines of evidence including some new developments.

The 66% range is 2.6–3.9 K for our Baseline calculation and remains within 2.3–4.5 K under the robustness tests; corresponding 5–95% ranges are 2.3–4.7 K, bounded by 2.0–5.7 K (although such high-confidence ranges should be regarded more cautiously). This indicates a stronger constraint on $S$ than reported in past assessments, by lifting the low end of the range. This narrowing occurs because the three lines of evidence agree and are judged to be largely independent and because of greater confidence in understanding feedback processes and in combining evidence.

We find that a large volume of consistent evidence now points to a more confident view of a climate sensitivity near the middle or upper part of this range. In particular, it now appears extremely unlikely that the climate sensitivity could be low enough to avoid substantial climate change (well in excess of 2°C warming) under a high-emission future scenario. We remain unable to rule out that the sensitivity could be above 4.5°C per doubling of atmospheric carbon dioxide, although this is not likely.

We identify promising avenues for further narrowing the range in $S$, in particular using comprehensive models and process understanding to address limitations in the traditional forcing-feedback paradigm for interpreting past changes.

Continued research is needed to further reduce the uncertainty, and we identify some of the more promising possibilities in this regard.

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